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ANALISIS OF FAILURE IN PARTIALLY SATURATED SOILS

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ABSTRACT

In this work an analysis of failure condition of slopes in partially saturated soils appears using the extended MRS Lade model is presented. The elastoplastic constitutive model is based on an extension of the well-know MRS Lade model by Sture et al. [1], whereby the suction and effective stress tensor are introduced as additional independent and dependent component stress components, respectively [2].Consequently the cap and cone yield conditions of the MRS Lade model both in hardening and softening as well as the internal evolution laws in these regimes are redefined to include the dependency on the suction. Figure 1 illustrates the projection of the Extended MRS Lade model's yield surface in the meridian plane $\pi/3$ and its variation with the suction. The intersection of the yield surface with the $\mathbf{p_n}$ **- s** plane defines a Loading Collapse (LC) yield curve which accounts for the increase of the elastic regime with the increment of s while reducing this regime to its minimum when $s = 0$ (saturated soil).
The problem in study is a continuous layers implanted in the crest of a slope, in conditions of initial stability before being applied the loads of the layers of foundations and consequently the analysis is made in plane strain state. The analysis puts special emphasis in the influence of the design of the mesh of finite elements in the mechanism of failure of the slope and determination of the pick load.

Different meshes from finite elements and its influence in the determination of the ultimate load study, is made an analysis of the failure bifurcation condition and a procedure of alignment of the mesh based on the critical direction of bifurcation is applied. The analysis of the location is made of the same form and relations developed for the condition of propagation of flat acoustic waves in solids, according to Thomas [3] and Hill [4]. Therefore, the localization condition takes the form [5]:

$$[[\dot{\boldsymbol{\sigma}}]] = [[\dot{\boldsymbol{\sigma}}']] = \dot{\gamma}\, \mathbf{E}_{ep} : (\mathbf{N} \otimes \mathbf{M}) \qquad (1)$$

The numerical answer of ultimate capacity of load is compared according to the classic theory and the variation of the condition of stability due to changes of the suction content of the ground of the slope by infiltration of rainwater is studies.

Finally, the condition for discontinuous bifurcation in elastoplastic partially saturated porous media as well as the localized failure predictions of the proposed material formulation for different suctions are also analyzed and discussed. The localization analysis performed with the model demonstrates that the increment of the suction is related to a destabilizing effect as discontinuous bifurcation in the form of localized failure take place instead of diffuse or continuous failure modes. The results illustrate the relevant influence of the suction in the critical directions for localization

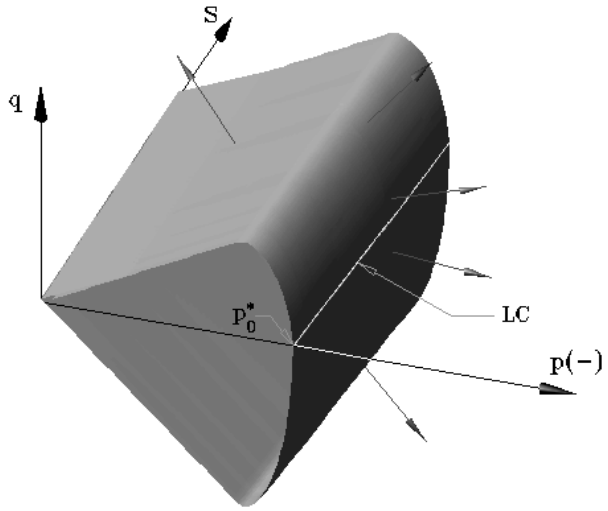

Figure 1.Extended MRS-Lade model's failure envelope in compressive meridian.

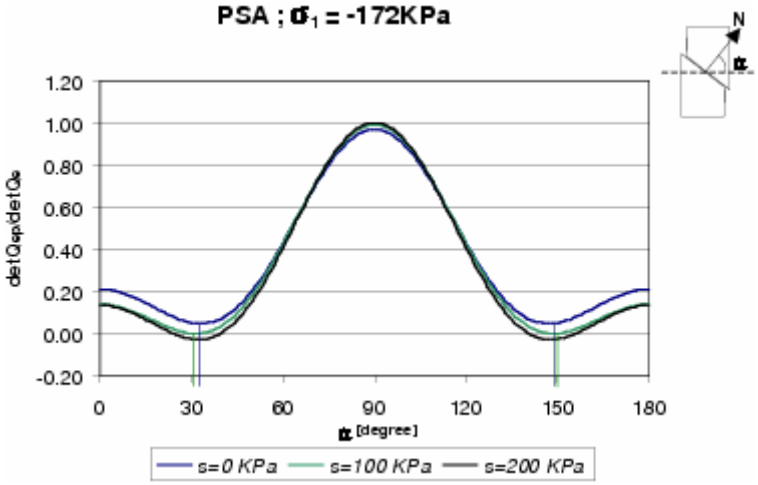

Figure 2.Localization at final stage of PSA test.

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